New Functionalization Methodologies for Nanostructured Metal Oxide Semiconductors

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Heterogeneous charge transfer mechanisms between a chromophore and an inorganic nanostructured metal oxide (MO_n M = Ti, Zn, Zr) semiconductor are fundamentally interesting, and are important for a variety of applications, ranging from photovoltaics to sensors. Yet, such processes remain poorly understood. A key challenge is to control the orientation of molecules, in particular dyes and redox active compounds, on the MO_n surface since interfacial heterogeneity of the nanostructured MO_n films can prevail, resulting in a broad distribution of molecular orientations. Such disorder can influence the performance of the devices, and will complicate kinetic analyses, thus decreasing our fundamental understanding of interfacial charge transfer. This talk will provide an overview of our most recent efforts in the development of "shielded" dyes, which are designed to achieve a better control of the molecule/MO_n interface. We will describe two binding strategies that we are using to shield the active group from the surface heterogeneity (illustrated below): the synthesis and study of homoleptic Ru(II) complexes and of host-guest complexes on semiconductors. The description of our efforts towards new step-wise functionalization strategies of ZnO nanostructured layers for sensors will also be discussed.